United Monolithic Semiconductors

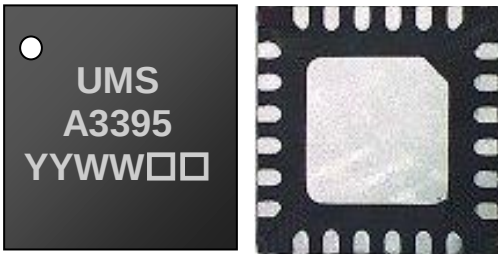
CHA3395-QDG

21-30GHz Medium Power Amplifier

GaAs Monolithic Microwave IC in SMD leadless package

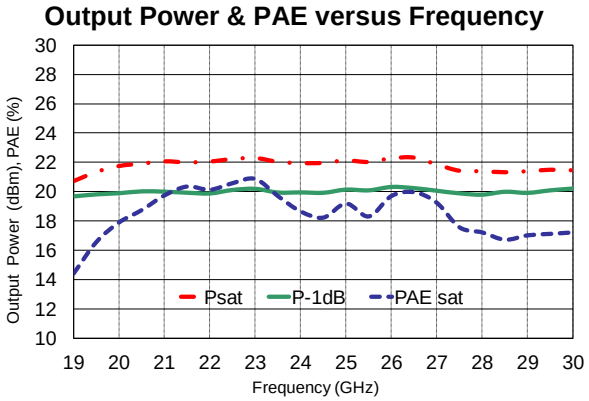
Description

The CHA3395-QDG is a 3 stage monolithic Medium Power Amplifier, which produces 24dB gain for 20dBm output power.
It is designed for a wide range of communication and sensor systems.
The circuit is manufactured with a pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.
It is supplied in RoHS compliant SMD package.



Main Features

- Broadband performances: 21-30GHz
- 20dBm Pout at 1dB compression
- 24dB gain
- 32dBm OTOI
- DC bias: Vd= 4.0V, Id= 180mA
- 24L-QFN4x4 (QDG)
- MSL1



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	21		30	GHz
Gain	Linear Gain		24		dB
P-1dB	Output Power @1dB comp.		20		dBm
OTOI	3rd order Intercept point		32		dBm

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Electrical Characteristics

Tamb.= +25°C, Vd = +4.0V

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	21		30	GHz
Gain	Linear Gain 21-29.5 GHz Linear Gain 30 GHz		24 21		dB
ΔG	Gain variation in temperature		0.023		dB/°C
G_{CTRL}	Gain control range		15		dB
OTOI	3rd order Intercept point		32		dBm
P_{-1dB}	Output power @ 1dB compression		20		dBm
Psat	Saturated Output Power		22		dBm
RLin	Input Return Loss		12		dB
RLout	Output Return Loss		20		dB
NF	Noise figure		4.5		dB
Id	Quiescent Drain current		180		mA
Vg	Gate voltage		-0.4		V

These values are representative of onboard measurements as defined on the drawing in paragraph "Evaluation board".

“Power ON” sequence

1. Ground the device
2. Bias MPA gate voltage at Vg low enough (Typically: Vg ≈ -1V)
3. Apply Vds bias voltage (Typically: Vd = 4V)
4. Increase slowly Vgs up to quiescent bias drain current Idq
5. Apply RF signal

“Power OFF” sequence

1. Turn off RF signal
2. Bias MPA gate voltage at Vg low enough (Typically: Vg ≈ -1V)
3. Turn Vds bias voltage to 0V
4. Turn Vgs bias voltage to 0V

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Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	4.5V	V
Id	Drain bias quiescent current	260	mA
Vg	Gate bias voltage	-2 to +0.4	V
Vdg	External drain-gate excursion	5	V
Pin	Maximum input power	6	dBm
Tj	Maximum junction temperature (2)	175	°C

(1) Operation of this device above anyone of these parameters may cause permanent damage.

(2) Thermal Resistance channel to ground paddle

Recommended Operating Range 3, 4

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	3.3 to 4	V
Id	Drain bias current	100 to 180	mA
Vg	Gate bias voltage	-1 to 0	V
Pin	Maximum peak input power overdrive	5	dBm

(3) Electrical performances are defined for specified test conditions

(4) Electrical performances are not guaranteed over all recommended operating conditions

Temperature Range

Ta	Operating temperature range	-40 to +95	°C
Tstg	Storage temperature range	-55 to +150	°C

Typical Bias Conditions

Tamb.= +25°C

Symbol	Pad Nº	Parameter	Values	Unit
VG1	8	DC Gate voltage 1st stage	-0.4	V
VG2	9	DC Gate voltage 2nd stage	-0.4	V
VG3	10	DC Gate voltage 3rd stage	-0.4	V
VD1	23	DC Drain voltage 1st stage	4.0	V
VD2	22	DC Drain voltage 2nd stage	4.0	V
VD3	21	DC Drain voltage 3rd stage	4.0	V

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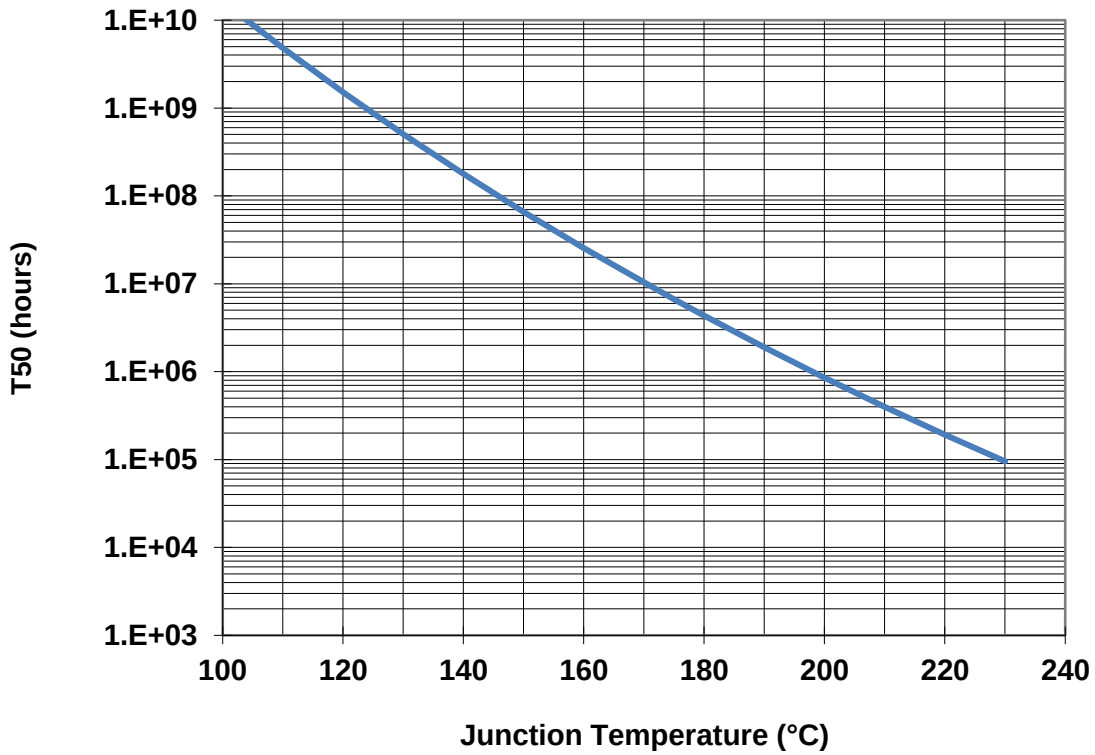
Device thermal performances

All the figures given in this section are obtained assuming that the QFN device is only cooled down by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase).
The system maximum temperature must be adjusted in order to guarantee that Tjunction remains below the maximum value specified in the Absolute Maximum Ratings table.
So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	R_{TH} (°C/W)	T50 (hours)
R_{TH} [1] Thermal Resistance (Junction to Case)	Vd= 4V Id= 180mA Pdiss= 0.72W	160	104.2	2.55E+07

[1] Assuming 85°C Tcase



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Typical Package Sij parameters

Tamb.= +25°C, Vd = +4V, Id = 180mA

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
2.0	-0.248	134.7	-45.771	-90.6	-45.697	-87.2	-0.956	108.5
3.0	-0.321	112.1	-47.841	-134.7	-47.822	-133.6	-1.028	73.3
4.0	-0.406	89.2	-49.902	178.2	-50.027	174.5	-1.111	38.2
5.0	-0.566	66.2	-52.448	131.3	-54.464	102.6	-1.185	4.2
6.0	-0.741	43.3	-56.671	93.9	-48.669	-54.8	-1.294	-30.2
7.0	-1.002	20.7	-58.972	65.8	-35.449	-137.5	-1.467	-64.5
8.0	-1.217	-1.0	-56.515	51.7	-25.922	146.4	-1.878	-100.1
9.0	-1.401	-22.8	-53.560	8.8	-18.764	80.9	-2.378	-137.1
10.0	-1.446	-45.1	-52.146	-47.8	-12.185	18.4	-3.516	-175.6
11.0	-1.537	-68.0	-51.166	-122.7	-6.018	-47.3	-5.698	144.9
12.0	-1.593	-91.2	-53.887	169.2	-2.293	-117.6	-7.491	113.8
13.0	-1.694	-115.3	-52.331	116.8	0.962	-174.8	-9.782	71.6
14.0	-1.802	-140.4	-52.864	94.3	4.120	132.5	-12.764	25.3
15.0	-2.038	-167.4	-48.824	60.5	7.315	79.3	-17.302	-25.2
16.0	-2.386	164.7	-49.545	25.9	10.538	27.5	-23.287	-90.2
17.0	-2.771	134.7	-48.459	-5.2	13.897	-25.2	-24.646	167.8
18.0	-3.704	101.8	-51.195	-11.6	17.390	-80.0	-21.302	89.8
19.0	-5.682	66.5	-49.274	-27.0	20.867	-139.7	-20.601	35.4
20.0	-9.147	35.9	-49.930	-54.7	23.702	154.1	-24.282	-11.7
21.0	-13.343	20.7	-53.842	-81.6	25.187	85.8	-36.158	-72.3
22.0	-15.557	23.0	-63.052	-119.0	25.682	19.3	-28.404	118.0
23.0	-14.735	14.9	-52.763	70.8	25.425	-41.9	-24.143	54.2
24.0	-14.223	1.8	-44.146	29.6	25.358	-101.3	-20.243	38.7
25.0	-14.942	-16.7	-42.113	-0.6	25.087	-159.7	-20.014	3.8
26.0	-12.836	-33.9	-38.859	-32.8	24.638	141.9	-20.616	-37.2
27.0	-13.081	-55.4	-37.970	-52.2	24.065	81.8	-23.604	-63.0
28.0	-12.061	-75.7	-36.839	-80.7	23.043	23.8	-27.614	-135.7
29.0	-11.164	-94.0	-36.137	-118.9	22.085	-37.6	-47.413	24.6
30.0	-8.196	-117.3	-37.297	-137.0	20.625	-100.1	-21.920	-105.8
31.0	-5.362	-150.9	-41.111	-147.0	18.145	-168.2	-11.117	171.6
32.0	-3.294	171.4	-40.548	-144.8	14.141	126.7	-7.197	116.5
33.0	-2.260	136.9	-41.892	178.8	9.098	68.4	-4.788	68.3
34.0	-1.639	108.1	-44.323	-169.4	3.706	16.2	-4.107	23.0
35.0	-1.158	82.9	-43.009	-176.7	-1.699	-33.4	-4.062	-24.4
36.0	-0.974	60.4	-41.384	-163.1	-7.649	-83.0	-4.509	-84.5
37.0	-0.718	40.2	-36.637	179.9	-14.806	-131.5	-4.549	-156.3
38.0	-0.732	21.5	-36.392	148.1	-23.583	-173.3	-3.186	139.8
39.0	-0.676	4.4	-36.059	121.7	-33.144	163.4	-2.309	92.8
40.0	-0.718	-11.6	-36.479	95.8	-39.488	150.6	-1.535	58.1

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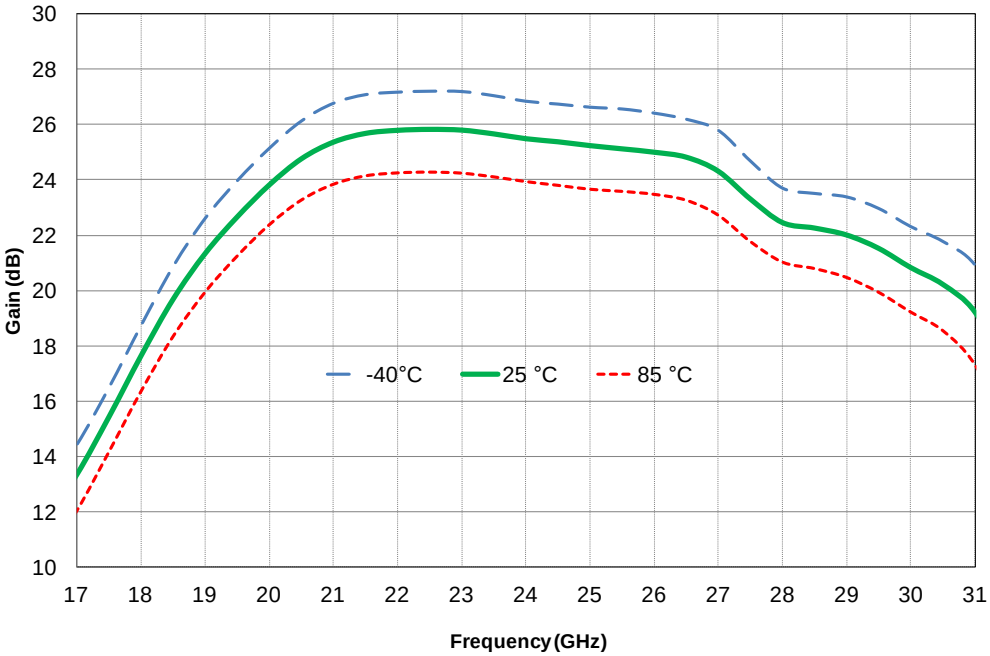
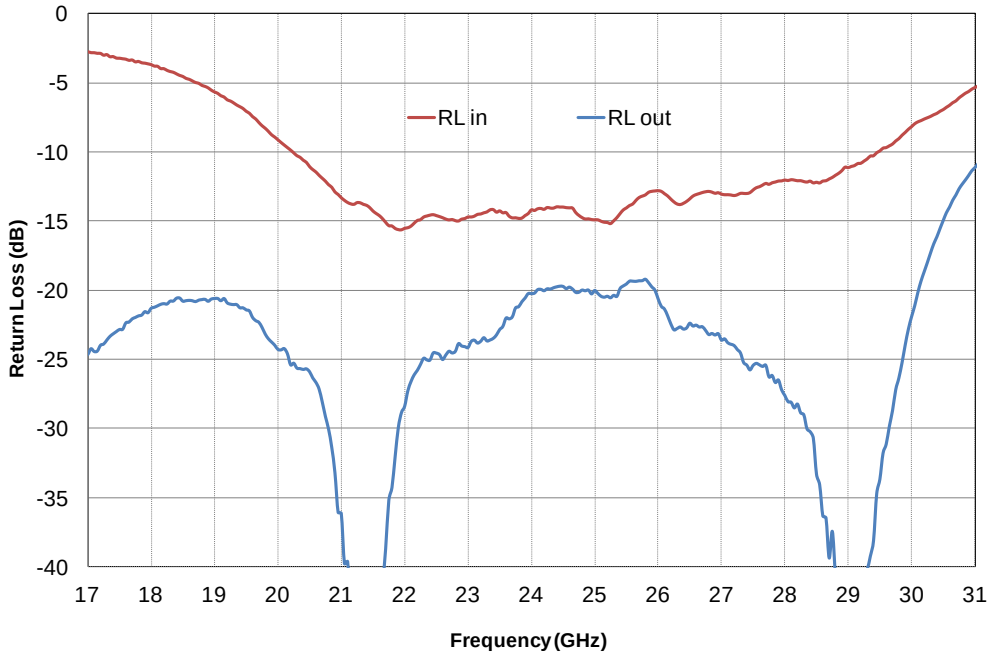
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 180mA
These values are representative of onboard measurements as defined on the drawing in paragraph "Evaluation board".

Linear Gain versus Frequency in Temperature



Return losses versus Frequency



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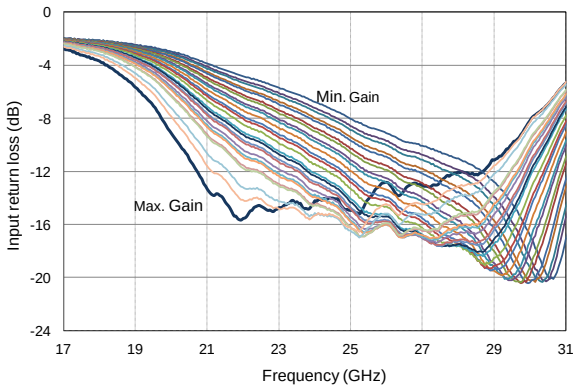
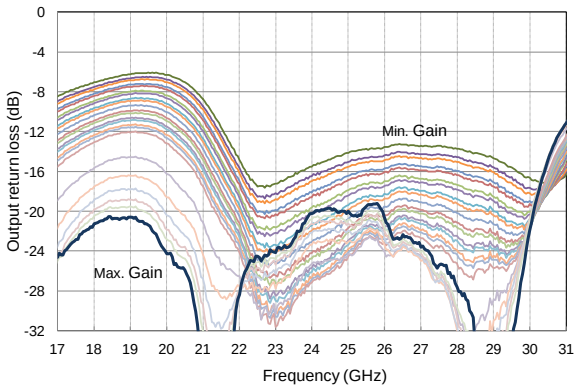
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 180mA

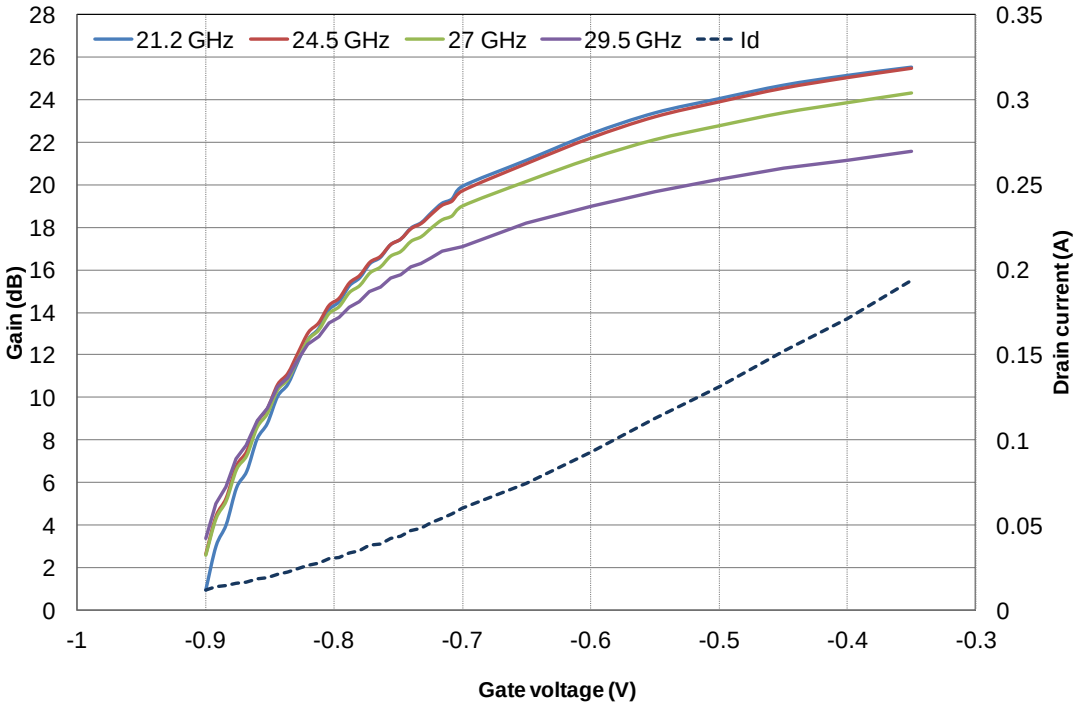
Input return loss versus gain ctrl



Output return loss versus gain ctrl



Linear gain & Current versus Gate Voltage



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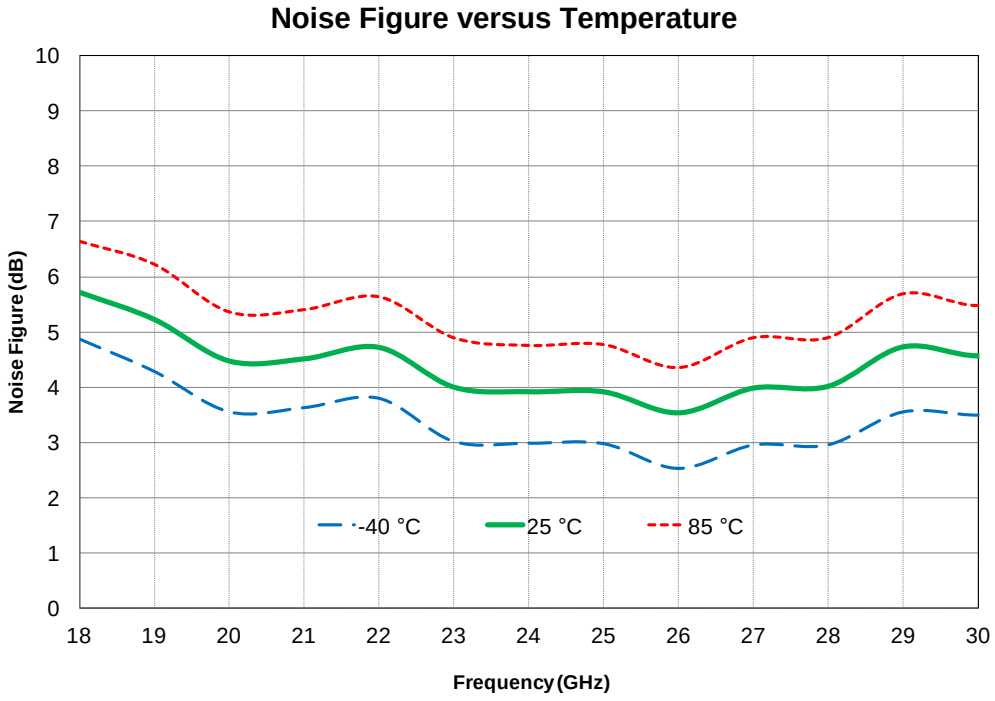
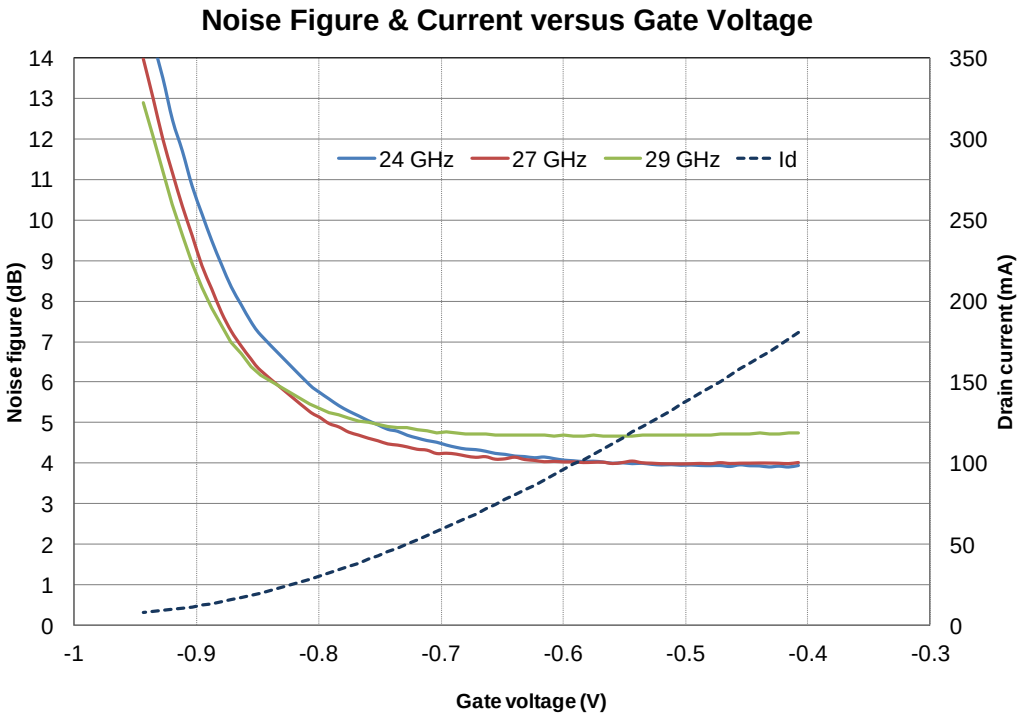
Tamb.= +25°C, Vd = +4.0V, Id = 180mA





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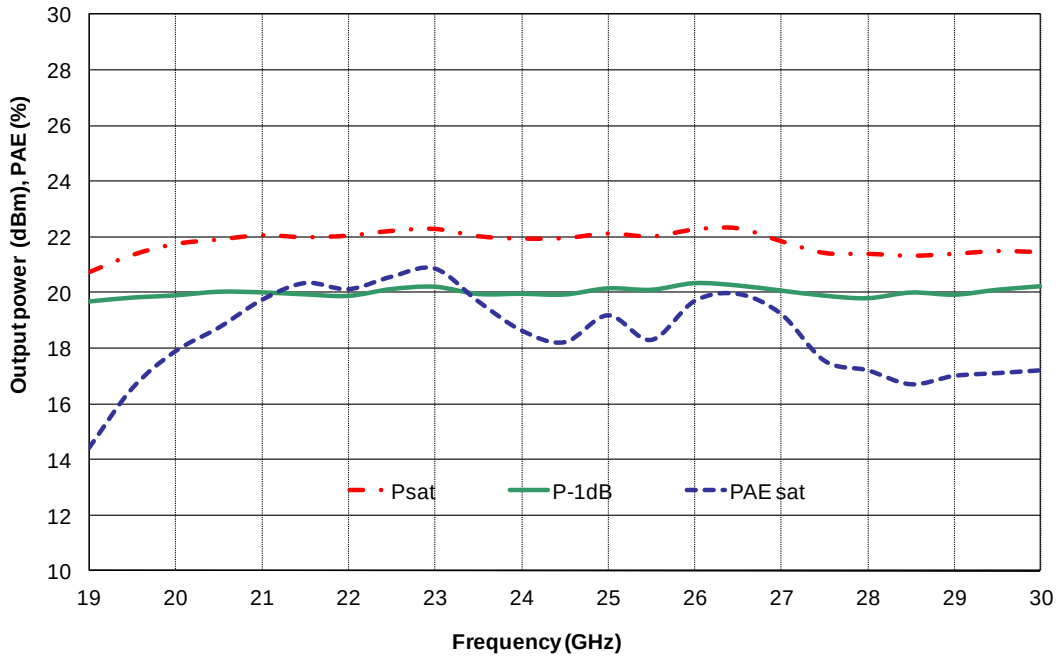
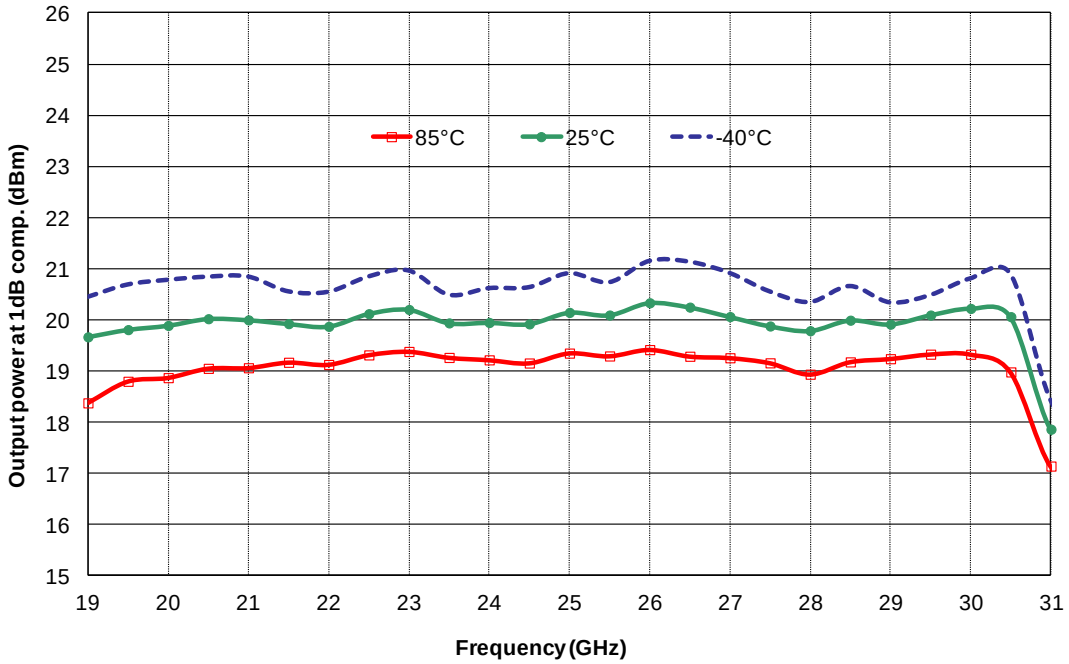
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 180mA

Output Power & PAE versus Frequency



Pout at 1dB compression versus Temperature



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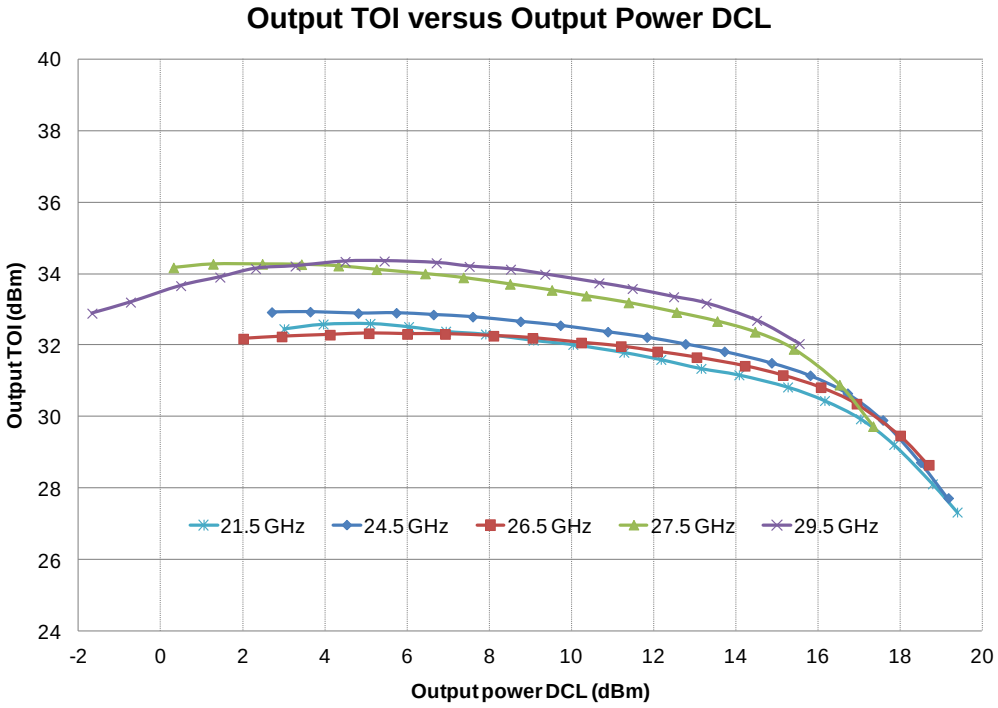

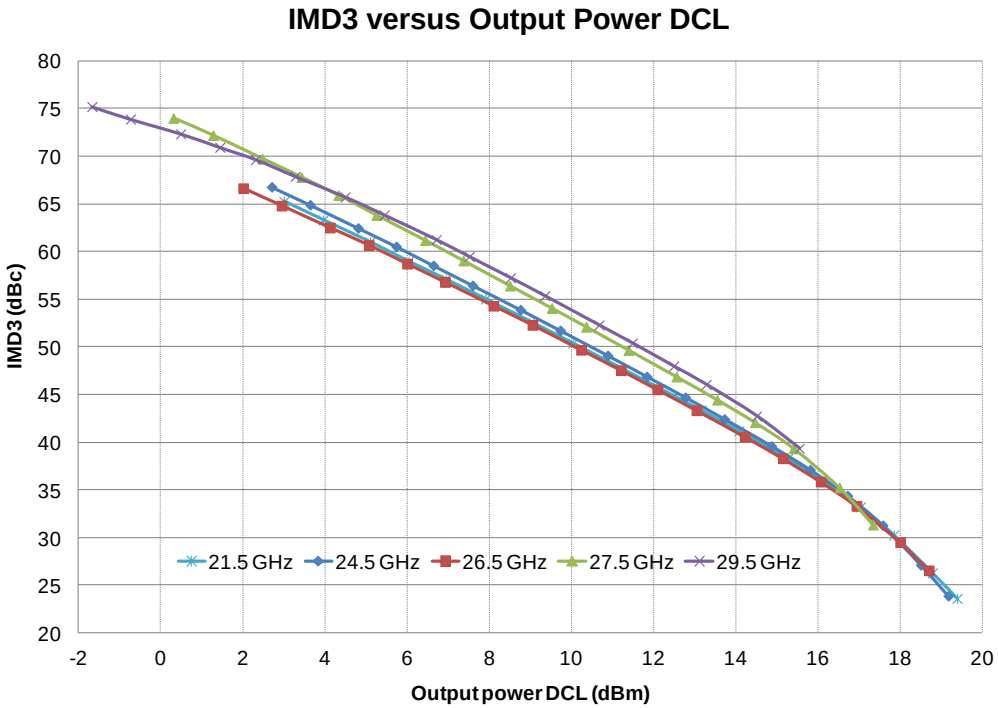

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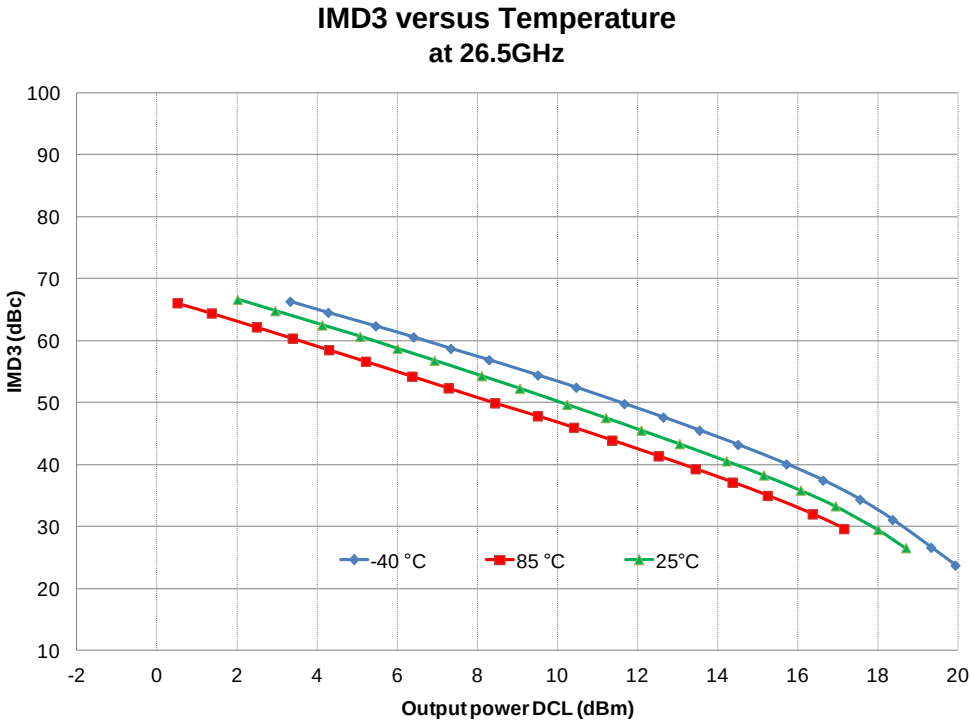

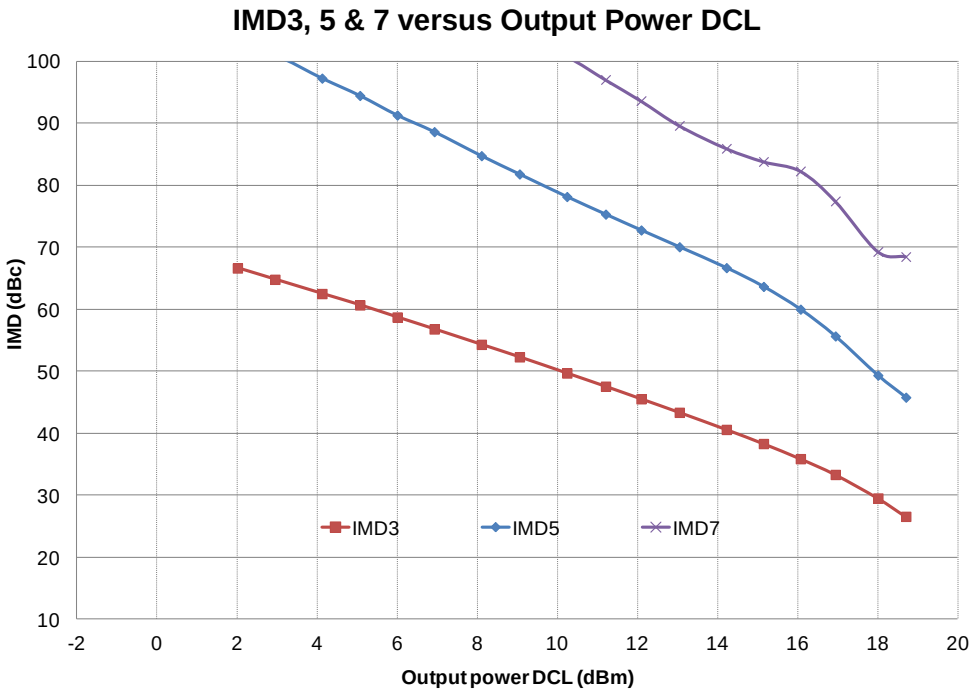

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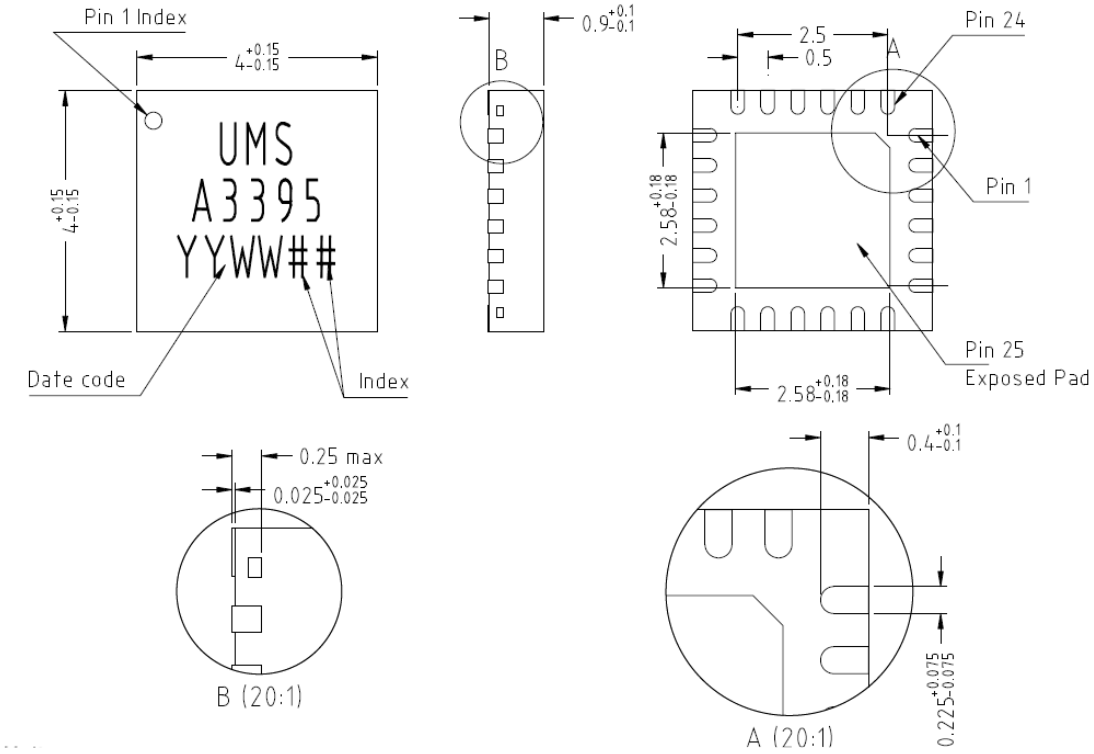
Package outline (1)



Matte tin, Lead Free (Green)	1- NC	9- VG2	17- Gnd(2)
Units : mm	2- Gnd(2)	10- VG3	18- NC
From the standard : JEDEC MO-220	3- Gnd(2)	11- NC	19- NC
(VGGD)	4- RF IN	12- NC	20- Gnd(2)
25- GND	5- Gnd(2)	13- Gnd(2)	21- VD3
	6- Gnd(2)	14- Gnd(2)	22- VD2
	7- NC	15- RF OUT	23- VD1
	8- VG1	16- Gnd(2)	24- NC

(1) The package outline drawing included to this data-sheet is given for indication. Refer to the application note AN0017 (https://www.ums-rf.com) for exact package dimensions.

(2) It is strongly recommended to ground all pins marked “Gnd” through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

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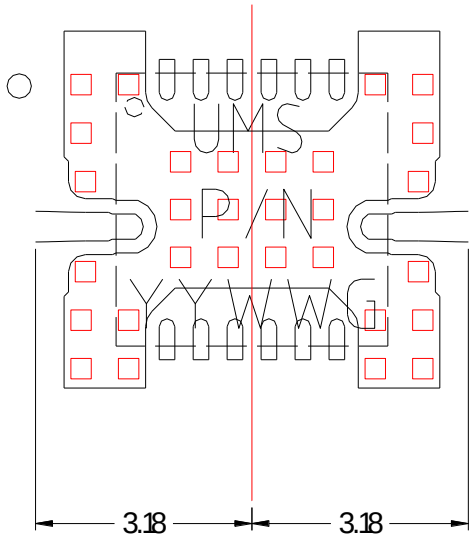
Definition of the Sij reference planes

The reference planes used for Sij measurements given above are symmetrical from the symmetrical axis of the package (see drawing beside). The input and output reference planes are located at 3.18mm offset (input wise and output wise respectively) from this axis. Then, the given Sij parameters incorporate the land pattern of the evaluation motherboard recommended in paragraph "Evaluation board".



ESD sensitivity

Standard	Value
MIL-STD-1686C	HBM Class 1
ESD STM5.1-1998	HBM Class 1A

Package Information

Parameter	Value
Package body material	RoHS-compliant
	Low stress Injection Molded Plastic
Lead finish	100% matte tin (Sn)
MSL Rating	MSL1

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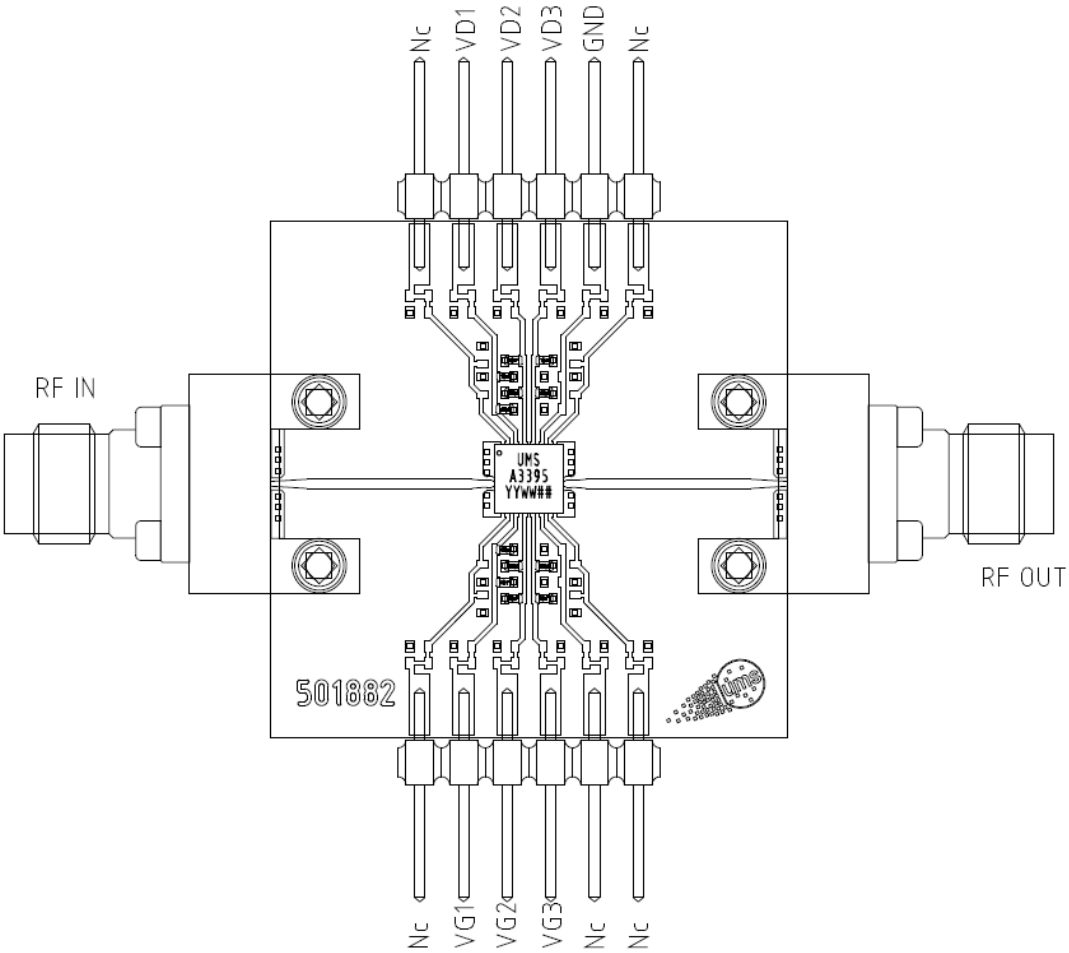
Evaluation board

- Compatible with the proposed footprint.
- Based on typically Ro4350 / 10mils or equivalent.
- Using a micro-strip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.
- Decoupling capacitors of 100pF ±5% and 10nF ±10%are recommended for all DC accesses.
- See application note AN0017 for details.



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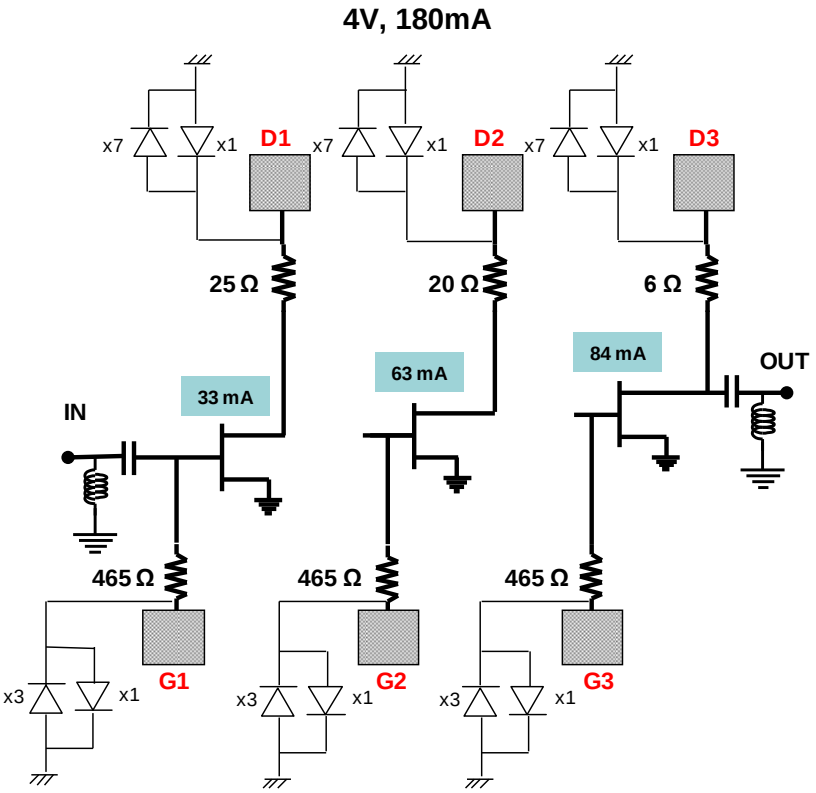
Notes

Due to ESD protection circuits on RF input and output, an external capacitance might be requested to isolate the product from external voltage that could be present on the RF accesses.

ESD protections are also implemented on all DC accesses.
The DC connections do not include any decoupling capacitor in package, therefore it is mandatory to provide a good external DC decoupling on the PC board, as close as possible to the package.

DC Schematic



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Recommended package footprint

Refer to the application note AN0017 available at https://www.ums-rf.com for package foot print recommendations.

SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017.

Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at https://www.ums-rf.com.

Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations for the UMS package products.

Ordering Information

QFN 4x4 package:	CHA3395-QDG/XY	
	Stick: XY = 20	Tape & reel: XY = 21

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